ROYAL ASTRONOMICAL SOCIETY.

VOL. XVII. *November* 14, 1856. No. 1.

MANUEL J. JOHNSON, Esq., President, in the Chair.

J. P. Radcliffe, Esq., Rudding Park, Yorkshire, was balloted for and duly elected a Fellow of the Society.

Occultation of Jupiter by the Moon. Observed at Canonbury November 8th, 1856. By Warren De la Rue, Esq., Ph.D. F.R.S.

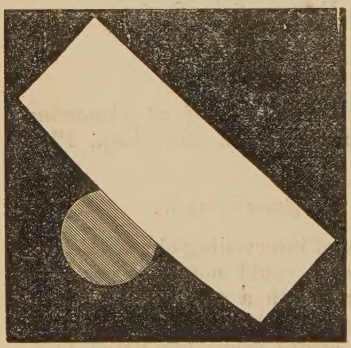
Latitude 51° 32′ 40″·6 N.; longitude 23ˢ·24 W.

In consequence of the existence of intervening objects the first contact of the moon with the planet could not be observed in my observatory, but it was watched with a small achromatic of only one and a half inches aperture, with which, however, the time of contact might have been pretty accurately noted, had a chronometer been at hand, so excellent was the definition. But when the contact had fairly taken place, the planet had emerged from behind the surrounding objects and afforded me an opportunity of watching the progress of the moon's northern limb across the planet's disk with an excellent $2\frac{1}{2}$ object-glass of Ross, magnifying 120 diameters and mounted equatoreally by Simms. With this instrument the moon's limb was estimated to extend to within 3″ of the southern edge of the dark southern belt of *Jupiter*, which had been found by previous micrometrical measurements to be distant 13″·95 from his southern edge, so that the overlapping would be about 11″. I was much struck with the pale and evidently greenish hue which the planet presented in contrast with the moon's conspicuously warmer tints, and also with the much greater brightness of most portions of the lunar surface; for *Jupiter* was not even quite so bright as *Plato*, which by comparison appeared of a brown colour. I did not wait to observe the moment of emergence with the achromatic, as I hoped to be able to do so with my Newtonian equatoreal, but I could not get a sight of the planet until the moon was fairly separated by a streak of black sky; I was, however, able to confirm most satisfactorily the observations in regard to the relative tint and brilliancy of *Jupiter* as compared

with the moon, made with the smaller instrument. The shadow of the first satellite on the dark southern belt was distinctly seen and had been observed in the $2\frac{1}{2}$-inch telescope; and at $4^h\ 22^m\ 26^s{\cdot}9$ local sidereal time, the fourth satellite (the only one visible) reappeared from behind the moon at about $2''$ from its limb; the disappearance of this satellite unfortunately could not be noted for the reason before mentioned.

Observation of the Occultation of Jupiter by the Moon, November 8, 1856. By W. Huggins, Esq.

"*Jupiter* appeared to run along the edge of the moon without contact for nearly a minute.



First Apparent Contact,
$4^h\ 30^m\ 3^s$ G.S.T.

Last Apparent Contact,
$4^h\ 36^m\ 38^s$ G.S.T.

"Edge of moon on *Jupiter* appeared to approach the upper equatoreal belt within about $4''$.

"Dusky appearance of *Jupiter* as contrasted with the moon very marked.

"First satellite very visible.

"Fourth satellite not seen during the occultation.

"Telescope, 5 inches aperture; power, 160.

"*Upper Tulse Hill.*"

Observation of the Occultation of Jupiter, 8th November, 1856. By T. W. Burr, Esq.

"In consequence of the interest excited by the phenomena on this occasion, I am induced to add my notes of the occurrence to the accounts already before the Society.

"It was difficult to determine when the occultation really commenced, as the planet appeared to graze along the moon's limb for some little time at a part which was still rugged; but I believe the immersion may be stated to have occurred at $4^h\ 28^m\ 54^s$ local sidereal time. A slight cloud then formed, but was speedily dissipated, and at $4^h\ 30^m\ 18^s$ a distinct impression had been made on the planet's disk, which was then immediately under *Plato*, where the moon's limb was fully illuminated. The emersion I consider took place at $4^h\ 35^m\ 16^s$, when a fine, but palpable, dark line became visible between the disks. This line was not visible before, but the line of demarcation between the two bodies and

the extent of the obscuration of *Jupiter* could be seen by the difference of their light; the planet being dusky, compared with the moon. I made the same observation on the night of the recent eclipse of the moon, when, on occasionally turning to the planet, its light, though strong, was evidently less brilliant in its character than that of our moon.

"About one-fourth of the planet's disk seemed occulted; the whole of the mass of polar shading being covered, but a bright band remained above the upper equatoreal belt. The first satellite had come off the planet's disk about nine minutes before the occultation commenced, and was steadily visible during the whole time. Its shadow remained on the planet, and was likewise seen, as were the two principal belts and the fine ones, near the lower pole. The fourth satellite was visible before the occultation, but disappeared while I was watching the planet, and could not be found afterwards. I believe it suffered an occultation by our moon.

"*Highbury, 17th November*, 1856."

Note on the Occultation of Jupiter, November 8, 1856.
By W. R. Grove, Esq. F.R.S.

"I had a good position for witnessing the partial occultation of *Jupiter* from an upper room of my house, situate opposite Clarence Gate, Regent's Park. I used a small, but unexceptionably good achromatic telescope, $1\frac{3}{4}$-inch aperture and 22 inches focus; the magnifying power was 43.

"It seemed to me—(but I attach little value to the observation, as the effect might have been due to an agitation in the Earth's atmosphere)—that at the moment before immersion the margin of *Jupiter* was slightly elongated, or, so to speak, stretched itself out to meet the Moon; this was followed immediately by a flattening of the same portion of the disk.

"Throughout the whole period a dark line was plainly perceptible between *Jupiter* and the Moon. This line appeared to me straight, as though cutting off the convexity both of *Jupiter* and the Moon. The light of *Jupiter* was notably less brilliant than that of the Moon; I should say hardly equal to half the intensity of the latter. It was of a much bluer tint than the Moon, probably an effect of contrast arising from the different intensities of their respective lights. The belts of *Jupiter* were plainly seen throughout the occultation, and, as far as I could observe, were not in any respect distorted.

"The dark line I thought at first arose from the intervention of a fine rim of the dark body of the Moon, but this could hardly be the case towards the termination of the occultation. About a fifth part of the planet appeared to me to be occulted at the maximum period."

Note on the Occultation of Jupiter. By J. F. Goddard, Esq.

"I take the liberty of sending you an account of my observation of this phenomenon. I used an achromatic telescope of $4\frac{1}{8}$-inch aperture, and power of 200. Circumstances were very favourable; not a cloud passed, there was little or no wind, and the smoke of London did not drift in our direction.

"The planet approached the north point of the moon's limb nearly in the direction of a tangent to that point, passing the invisible limb at a small distance, and making its first contact with the moon at the limit of light and darkness; it remained on the edge a little while, and one-fourth of its disk was gradually obscured, a darkish line being sensible between. The planet glided along the bright circular outline of the moon; its hue was duller than that of the moon. I could not affirm that any alteration of size or figure occurred, but I took no measurements. The centre of *Jupiter* was not occulted, only, as near as I could guess, one-fourth of his diameter. The belts and one satellite were conspicuous all the time.

"The observation was made about half-a-mile south of Hounslow Railway Station.

"*Jesse Cottage, Whitton, near Isleworth, November 13th*, 1856."

Note respecting the Occultation of Jupiter by the Moon. By Lord Wrottesley.

"We looked out for the occultation of *Jupiter*, but none took place here. The moon passed about four diameters of *Jupiter* to the south of the planet. We observed, however, an eclipse of the third satellite of *Jupiter* by the planet.

"Disappearance at $11^h\ 9^m\ 45^s$, M. T. at Wrottesley.

"Reappearance at $13^h\ 52^m\ 41^s$ M. T. ,,

"The former gives a very fair longitude.

"*Wrottesley, Nov.* 10, 1856."

Observation of a Lunar Occultation of Jupiter's fourth Satellite, made at Haddenham, Bucks, November 8, 1856. By the Rev. W. R. Dawes.

"The conjunction of the moon with *Jupiter* on the 8th of this month presented, as seen from this place, the rare phenomenon of an occultation of a satellite, while the planet itself escaped being even partially occulted. At the nearest approach, the southern limb of *Jupiter* was still about 20″ or 25″ by estimation from the

northern edge of the moon. The fourth satellite was the only one visible until within a few minutes before the time of conjunction, when the egress of the first took place (at about $13^h\ 5^m$ G. M. T.). Being in the south-following portion of its apparent orbit, it was caught by the moon in consequence of her rapid advance in declination northward, disappearing at the dark edge of the moon, and reappearing at the bright edge. My large equatoreal not having been remounted since my removal from Wateringbury, I employed a very perfect refractor by Merz of Munich, having an aperture of only $2\frac{1}{2}$ inches. With this the fourth satellite, though at times faint, and seen with difficulty when the air was much disturbed, yet was traced satisfactorily up to the moon's dark edge; but at the reappearance of the bright edge, it was not seen with certainty till it was distant from the limb about two of its own diameters. The duration of its occultation is therefore uncertain. The shadow of the first satellite was very obvious on the large belt in the southern hemisphere of the planet.

"P.S. The approximate geographical position of my present temporary residence is: longitude, $3^m\ 40^s$ west; latitude, $51°\ 46'$ north.

"*Haddenham, Bucks, 10th November*, 1856."

In answer to some inquiries on the part of Mr. De La Rue, Mr. Dawes makes the following observations:—

"I am obliged by your note of the 12th, to which I have been, till now, unable to reply. I was struck, as you were, with the difference of tint of *Jupiter* and the moon. Though the approach was so much closer as seen from here than at Nottingham, I did not perceive the slightest distortion of *Jupiter's* form similar to that described by Mr. Lowe in his letter to the *Times*.

"*Haddenham, Bucks, 20 Nov.* 1856."

Observations of Jupiter, during October 1856. By Warren De la Rue, Esq., Ph.D., F.R.S.

"*Jupiter* has been during the present apparition a most remarkable and interesting object, both on account of the great amount of detail to be seen on his belts, and also of the changes which obviously occur in them during very short intervals. The general appearance of the belts recalls very vividly the mottled and streaked appearance frequently presented by clouds, but no description can convey an accurate notion of the markings on the planet without the aid of graphic representations. There is, however, very great difficulty in making drawings of *Jupiter*, in consequence, partly of the overwhelming amount of details to be seen, and partly on account of the short period allowed by the rapid axial rotation of the planet for their delineation. For unless the drawing be completed within twenty to thirty minutes at most,

the change of aspect will have become so great, in consequence of the foreshortening and disappearance of some parts, and the fresh appearance and the elongation of others, that no reliable result will be obtained. And it frequently happens, moreover, that observations begun most auspiciously are rendered useless by the definition suddenly becoming bad and continuing so during the short interval at command; and by the time the atmosphere has quieted, the planet may have rotated so much that it is necessary to recommence, to be disappointed possibly again and again. Notwithstanding many such disappointments I am enabled to lay before the Society four faithful drawings, three of them executed by myself, and the fourth by my chemical assistant and friend Dr. Müller, who is a rapid and accurate draughtsman, and whose faithfulness in planetary delineation I have had many opportunities of testing.

"The southern belt of *Jupiter* appeared, on most occasions on which I have observed it, to be somewhat darker than the northern, which has always been more diffuse and more broken up by intervals and streaks; the northern also has invariably been the broader of the two. Both belts are unmistakably brown as compared with the general tint of the planet, which, about the poles, has a decidedly yellow hue, and more obviously so towards the north. Besides the very conspicuous broad belts, there were observed several delicate and faint streaks extending to a greater or less distance across the disk, but seldom entirely across it; these faint streaks just under the north belt were decidedly yellow. On the eastern limb of the planet (the most distant from the sun), I have observed a decided amount of shading, an observation confirmed by Dr. Müller.

"The belts of *Jupiter* have been usually represented to be bounded by straight lines: in former years I have always had the impression of an appreciable amount of curvature in them, and this observation I have been enabled to confirm during the present apparition. The belts are now so irregular in outline that it is quite necessary to watch for a favourable opportunity in order to test this impression satisfactorily; and it is absolutely essential that there should be no atmospheric tremor; fortunately such a rare occasion was presented on the 30th October at $7^h\ 50^m$ G.M.T. when the northern belt was sufficiently regular in its southern outline to admit of its elliptical form being made evident by laying a spider line tangentially upon it; the curvature, though very apparent, is small, and has its convexity towards the southern limb.

"The drawings represent the planet at the following epochs: October 12th, 12th hour G.M.T.; October 25th $9^h\ 8^m$ with the first satellite and its shadow upon the disk; and two drawings on October 27th, the one at $8^h\ 50^m$, the other by Dr. Müller at $9^h\ 45^m$, when the planet had rotated $33°\ 15'$. The drawings of October 12th, and the first drawing of October 27th, represent the same hemisphere (the difference being only $15°\ 29'$) and show very clearly the changes which during the interval had taken place in the belts which still retained some of their general features.

"The drawing of the 12th October was made in an ellipse set out previously from the data given in the *Nautical Almanac* to the scale adopted in all my previous drawings, namely, 0·125 inch to the second of arc; the dimensions and positions of the belts being eye observations. The figure was, however, so obviously too flattened an ellipse, that I was induced to measure the planet, and obtained a complete confirmation of my suspicion; on all other occasions I have made measurements not only of the planet, but also of his belts before commencing a drawing. I subjoin the results in so far as they relate to the polar and equatoreal dimensions of the planet, reserving the full details for another communication. I have reduced the observations also to the mean distance 5·20279, adopted by Mr. Main in his valuable paper 'On the Diameters of Planets having Measurable Disks.' The inclination of the belts was found to be:—

Oct. 12 ..... 23° 25′

,, 30 ..... 26 34

Date of Observation.	Observed		Reduced		Deduced Ellipticity neglecting the Slight Correction for Phase.*
	Equatoreal Diameter.	Polar Diameter.	Equatoreal Diameter.	Polar Diameter.	
1856.	Means of Eight Measures.	Means of Eight Measures.			
	″	″	″	″	
Oct. 25	47·500	44·800	37·247	35·131	0·05681
27	47·080	44·720	37·075	35·217	0·05011
30	46·793	44·267	37·100	35·090	0·05418
			37·141	35·146	$0·05370 = \frac{1}{18·62}$

Telescopic Appearances of the Planet Saturn during the Apparition of 1855–6, as observed with an 8-inch Object-glass. By the Rev. W. R. Dawes.

This communication will be published *in extenso* in another form. In commencing, Mr. Dawes states that "the object-glass, with which the following observations were made, is the work of Mr. Alvan Clark, of Boston, U.S., the same excellent maker who furnished me with the 7½-inch glass, with which I observed the previous year. Its focal length is 10 feet;—rather too great for convenience in my dome, which was constructed for an 8½-foot telescope: and the artist is therefore only waiting for unexceptionable materials wherewith to construct an object-glass of

* Mr. Main remarks that, if the *Correction for Phase* were allowed for, the resulting ellipticity would be nearly identical with his own determination.

the same aperture, with a considerable diminution of focal length The present 8-inch is a remarkably clear and sharp definer; and has afforded me some of the finest views of *Saturn* which I have ever enjoyed. Under suitable circumstances, it shows a minute but clear separation between the components of γ^2 *Andromedæ*."

The observations that follow are extracts from the entries in his observatory journal made at the time of observation.

Outer Ring, distinguished by Mr. Dawes as A. The pencil line on the outer ring was observed on Dec. 15 and Dec. 18, 1855, and on Feb. 15, 1856.

Middle Ring B. The dark band near the inner edge of the middle ring was seen distinctly defined on many occasions; and Mr. Dawes thinks that the bright line close to its inner edge is broader and less bright than on former occasions. Mr. Dawes notices an appearance of indistinctness on a part of the inner edge of the middle ring, which seems to confirm the opinion already placed on record by Mr. De la Rue, respecting the overlapping of the dusky ring on the middle ring.

"The inner edge of B is remarkably less distinct on the eastern side than on the western. I cannot account for this.

"1855, Dec. 19. Mr. F. Barrow visited the Observatory, and saw *Saturn*. . . . Without any intimation from me, he noticed the less defined appearance of the inner edge of the ring B on the south-following (or south-eastern) side; and suggested that it might be owing to the plane of the obscure ring C being inclined to that of the bright rings. This strikingly confirms my observation of last night.

"1855, Dec. 20. The same difference in the distinctness of definition of the inner edge of B on the eastern side and on the western is noticed, as I have before recorded."

Obscure Ring C. Mr. Dawes notices differences in the tint of different portions of the dusky ring, and that its light fades off towards its inner edge. He also, on one occasion, Nov. 15, 1855, made out a black line between it and the inner edge of the middle ring; but on the preceding side only.

The Ball. Mr. Dawes has paid particular attention to the markings on the disk of the planet, and also on the extent to which its southern limb covered the principal division between the outer and middle rings; the following observations relating to the period of the greatest opening of the rings are of interest.

"1855, Dec. 15. I cannot be sure that any part of the division is visible at the southern point of the ball, which I believe entirely covers it.

"1856, Jan. 29. I think the whole breadth of the division between A and B is not entirely covered by the ball, though I believe the greater part of it is so. . . . No very distinct belts on the ball. The polar belt appears to be less dark than it was during the earlier part of this apparition; and so is the narrow belt at about 40° south latitude.

"1856, Feb. 15. The southern edge of the ball does not

cover more than from one-half to two-thirds of the division between A and B.

"1856, Feb. 16. The southern edge covers, I think, rather more than half the breadth of the division . . . . The narrow belt, at about 45° or 50° of south latitude, is at times well brought out.

"1856, March 24. The ball appears to me to cover a small portion of the breadth of the division; but the air is scarcely favourable enough to determine it.

"1856, March 28. I cannot feel certain of the continuation of the division beyond the southern edge of the ball.

"1856, April 4. Very careful scrutiny leaves no doubt on my mind that the division between A and B is partly covered by the southern edge of the ball. When vision is finest, an extremely narrow dark line, like a hair, is seen to extend across the top or southern point of the ball; beyond which it is soon lost in the shadow of the ball."

Shadow of the Ball. The observations of the shadow of the ball on the rings extend from Nov. 15th, 1855, to April 4th, 1856.

On March 24, 1856, he remarks:—"The shadow of the ball certainly falls on A. The exterior edge of the shadow on B has a pretty regular though slight convexity, and is not *recurved* at the exterior edge of B, where the shadow of the ball joins the division between A and B."

The paper also contains several observations of *Enceladus*.

In conclusion he remarks:—"In No. 1017 of the *Astron. Nachr.*, Professor Secchi has given a brief account of the admirable performance of the large refractor by Merz, at the Observatory of the Collegio Romano; in which is the following remark respecting the position of the southern edge of the ball of *Saturn* on 1855, Dec. 16. 'The vertex of the globe scarcely touched the edge of the ring A.'

"It seems, therefore, that at that time Professor Secchi's impression almost perfectly coincided with my own.

"I ought, perhaps, here to offer a word or two in explanation of an expression which I employed when referring to this point in my paper printed in the *Monthly Notices* for 1855, Jan. 12, and in No. 971 of the *Astron. Nachr.* When I there spoke of 'a change to a considerable, and, in fact, *unaccountable*, amount having taken place,' if certain observations were correct, I intended simply to say, that there was *no well-known or recognised cause*, which was sufficient to account for it:—the variation which had occurred in the obliquity of the plane of the ring being obviously insufficient. Several causes, *more or less probable*, might be assigned for it, as Professor Secchi has shown in his remarks on my expression; but to such I was not referring when I used it.

"*Haddenham, near Thame,*
October, 1856."

Note on the Division of the Outward Ring of Saturn. By John Hartnup, Esq., Astronomer to the Liverpool Observatory.

"I have on several occasions been requested, both by Mr. Dawes and by Mr. Lassell, to try if I could make out the division in the exterior ring of *Saturn* with the equatoreal of this Observatory.

"On the 8th of November instant, after watching the near approach of *Jupiter* to the moon, with my friend Mr. Towson, I turned the telescope on *Saturn*. The definition was scarcely better than of average goodness, 27° being the highest power that the planet could be seen with to advantage. The semi-transparent ring was seen tolerably well, and the division in the exterior ring presented itself to my view in a few seconds. To put the matter beyond a doubt, I requested Mr. Towson to look at the exterior ring, and describe to me what he saw. After a careful examination, he drew on paper a sketch of the ring, which agreed precisely with my impression, placing the division about one-third the width of the ring from the exterior edge. I then showed Mr. Towson the beautiful engraving of Mr. De la Rue for 1852, and he immediately said that the division was too near the centre of the ring; but on his seeing Mr. De la Rue's engraving for 1856, he remarked that the division was correct. It is worthy of notice, that I have frequently seen *Saturn* better defined than on this occasion, with powers of 400 and 600, without being able to detect the division in the exterior ring.

"*Observatory, Liverpool,*
Nov. 13, 1856."

Note accompanying Drawings of Mars. By Capt. W. S. Jacob, Astronomer to the H. E. I. C.'s Observatory, Madras.

The accompanying drawings of *Mars* were taken at the last opposition. They are arranged and numbered, *not* in the order in which they were observed, but in that of the revolution of *Mars*, so as to give a better notion of the succession of phases. The date at which each was taken is given below. The colours have been represented as nearly as possible: the greenish hue, which some observers have remarked in the dark spots, was not noticed; the hue appeared similar to the usual appearance of the earth's shadow on the moon, which also is frequently considered to be green, but which (when not of a coppery tinge) always appears to the writer as a neutral brown or dun. Most of the marks appear to be quite permanent. Those near the south or upper Pole of No. 4, gave the impression of a chain of lakes somewhat similar to those of North America, but larger.

The instrument used was the Lerebours' equatoreal $f = 88^{in.}\cdot 6$ $ap = 6^{in.}\cdot 25$, power 277.

Dates of Observation.

No.	Madras Mean Time. d	h	m
1	April 11	7	0
2	May 15	6	45
3	,, 12	6	50
4	,, 7	6	15
5	,, 9	10	55
6	April 21	7	20
7	,, 16	6	50

There is rather a wide gap between No. 5 and 6, the interval being about 90° of longitude; the rest follow pretty regularly at intervals of 40° to 50° round the whole circumference. The drawings are made to a scale of $0^{in.}{\cdot}15$ to $1''$.

Madras, 11 *Sept.* 1856.

The beautiful drawings alluded to in this communication, together with those of Mr. De la Rue, Mr. Brodie, and those made at the Royal Observatory at Greenwich, have been referred to a Committee of the Council, with a view of mapping out the surface of *Mars*.

Note on the Observations of Antares. By J. Hippisley, Esq.

"In reference to the observations at p. 222, vol. xvi. of the *Royal Astronomical Society's Notices*, as to the impossibility of seeing *Antares* as a double star in these latitudes, I send the following extract from my observatory memoranda:

"1856, July 20, $8^h\ 30^m$, *Antares* in the meridian, · ● the small star very well seen, with powers 150 and 234.

"$8^h\ 45^m$, δ *Cygni*, saw the small star instantly with 234.

"July 30, $8^h\ 3^m$, *Antares* seen instantly and beautifully, · ● power 234, the small star about 1·5 diameter from the larger.

"I regret that I did not use a micrometer, but merely set down the position and distance by estimation; as in the diagram, which is a facsimile traced from my note-book, and represents the small star almost exactly 'preceding.'

"I am induced to send this extract as an instance, out of many I have experienced, of the great value of the half-hour at and after sunset, for the more delicate and difficult observations in all cases where the object has light enough to be well visible telescopically by daylight, such as exists at that period. This may probably arise from the short equilibrium between the heat of day and the chill of evening; during which atmospheric disturbances, arising from the intermixture of beds of air of different temperatures and densities, may be expected to be at a minimum.

"The observations were made with a $9\frac{1}{4}$-inch Newtonian equatoreal, and *without* any previous knowledge of the angle of position of the smaller star.

"*Ston Easton, Bath,*
Oct. 26, 1856."

Magnitudes of Thirty-six of the Minor Planets for the First Day of each Month of the Year 1857. By Norman Pogson, Esq., Assistant at the Radcliffe Observatory, Oxford.

(*Communicated by M. J. Johnson, Esq., Radcliffe Observer.*)

No.	Planet.	M.	Jan.	Feb.	Mar.	Aprl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	1858. Jan.
1	Ceres.....	7·5	7·4	7·1	7·1	7·4	7·8	8·1	8·4	8·6	8·8	8·9	9·0	8·9	8·8
2	Pallas.....	7·9	6·8	6·7	6·8	7·1	7·6	8·0	8·4	8·7	9·0	9·1	9·2	9·2	9·1
3	Juno	8·7	9·4	9·4	9·5	9·4	9·4	9·3	9·2	9·1	9·0	8·8	8·6	8·3	8·1
4	Vesta.....	6·4	7·0	7·3	7·6	8·0	8·2	8·4	8·5	8·5	8·4	8·3	8·1	7·8	7·5
5	Astræa	9·9	12·2	12·3	12·3	12·2	12·0	11·8	11·4	11·0	10·6	10·3	10·2	10·4	10·6
6	Hebe	8·5	9·2	9·1	9·2	9·6	10·0	10·4	10·7	10·9	11·0	11·1	11·0	10·9	10·7
7	Isis.....	8·5	10·5	10·2	9·9	9·7	9·7	9·9	10·3	10·6	10·8	11·0	11·1	11·1	11·0
8	Flora	8·7	10·4	10·4	10·4	10·3	10·2	10·1	9·9	9·7	9·5	9·3	8·9	8·6	8·4
9	Metis.....	8·7	10·5	10·6	10·5	10·5	10·3	10·1	9·9	9·5	9·1	8·7	8·2	7·9	8·0
10	Hygeia	9·8	11·1	11·3	11·4	11·4	11·4	11·3	11·1	10·9	10·6	10·3	10·3	10·4	10·7
11	Parthenope .	9·6	10·6	10·2	10·1	10·3	10·6	11·0	11·2	11·4	11·5	11·6	11·5	11·4	11·3
12	Victoria....	9·8	11·2	10·9	10·5	10·1	9·6	9·1	8·7	8·4	8·4	8·9	9·5	10·1	10·6
13	Egeria.....	9·7	11·4	11·2	11·0	10·7	10·3	10·1	10·2	10·4	10·8	11·1	11·4	11·6	11·7
14	Irene	9·8	11·8	12·0	12·1	12·1	12·1	11·9	11·7	11·4	11·1	10·7	10·4	10·3	10·5
15	Eunomia...	8·5	8·2	8·7	9·0	9·3	9·6	9·8	9·9	10·0	10·0	9·9	9·8	9·6	9·3
16	Psyche.....	10·0	10·7	10·5	10·5	10·7	11·1	11·4	11·7	11·9	12·0	12·0	12·0	11·9	11·7
17	Thetis	9·9	11·3	11·3	11·3	11·2	11·0	10·8	10·5	10·2	10·0	10·0	10·3	10·7	11·2
18	Melpomene.	9·4	9·0	9·6	10·1	10·6	10·9	11·2	11·5	11·6	11·7	11·7	11·6	11·4	11·1
19	Fortuna....	9·5	9·6	10·0	10·3	10·6	10·8	11·0	11·1	11·2	11·2	11·1	11·0	10·7	10·4
20	Massilia....	9·2	9·1	9·5	9·8	10·1	10·3	10·4	10·6	10·7	10·7	10·7	10·6	10·5	10·3
21	Lutetia	10·5	10·9	11·4	11·8	12·2	12·5	12·7	12·8	12·9	12·9	12·8	12·6	12·3	12·0
22	Calliope....	10·2	11·1	11·3	11·4	11·4	11·4	11·3	11·1	10·9	10·6	10·3	9·9	9·7	9·7
23	Thalia	10·7	11·0	11·3	11·4	11·5	11·6	11·6	11·5	11·5	11·4	11·3	11·1	10·9	10·7
24	Themis	11·6	12·3	12·6	12·8	12·9	12·9	12·9	12·8	12·6	12·4	12·1	11·7	11·3	11·1
25	Phocea.....	10·7	12·0	11·6	11·1	10·6	10·0	9·5	9·2	9·2	9·5	9·9	10·4	10·9	11·3
26	Proserpine..	10·8	11·3	10·9	10·6	10·6	10·9	11·2	11·5	11·8	12·0	12·1	12·2	12·2	12·1
27	Euterpe....	10·2	11·7	11·8	11·8	11·8	11·7	11·6	11·4	11·2	11·0	10·8	10·4	10·1	9·7
28	Bellona	10·3	11·7	11·9	11·9	12·0	11·9	11·7	11·5	11·3	10·9	10·5	10·1	9·7	9·6
29	Amphitrite .	9·1	9·0	9·4	9·8	10·1	10·4	10·6	10·7	10·8	10·8	10·8	10·6	10·4	10·1
30	Urania.....	10·1	12·1	11·8	11·5	11·1	10·8	10·7	11·0	11·3	11·6	11·8	12·0	12·1	12·1
31	Euphrosyne.	11·3	12·6	12·4	12·1	11·9	11·8	12·0	12·3	12·6	12·9	13·2	13·3	13·4	13·4
32	Pomona....	11·0	12·4	12·2	12·0	11·7	11·4	11·1	10·9	11·1	11·5	11·9	12·3	12·6	12·8
33	Polyhymnia.	11·2	13·2	12·9	12·7	12·7	12·8	13·1	13·3	13·4	13·5	13·5	13·4	13·3	13·0
34	Circe	11·6	13·5	13·6	13·7	13·6	13·5	13·3	13·0	12·7	12·3	12·0	11·8	12·0	12·3
35	Atalanta....	12·5	13·1	12·9	12·9	13·1	13·6	14·0	14·4	14·6	14·8	15·0	15·0	14·9	14·8
36	Fides	10·8	11·0	10·7	10·7	11·0	11·4	11·9	12·3	12·6	12·8	12·9	13·0	13·0	12·9

The column headed M in the preceding table gives the mean opposition-magnitudes for the thirty-six minor planets, ephemerides of which have been published in the supplement to the *Nautical Almanac* for 1860, *i. e.* the magnitudes such planets would have, if when in opposition both they and the Earth were at mean distance from the sun. These numbers have, for the most part, been deduced from estimated magnitudes near opposition, reduced to mean distance; and when such could not be obtained from my own or other observations, the values given by Prof. Argelander and

Dr. Bruhns, in their papers on the subject, have been adopted. (*Astronomische Nachrichten*, Nos. 928 and 1047.) The other columns furnish the magnitudes of the planets for the first day of each month, calculated on the assumed ratio of the light of 2·512, *i. e.* that a star of any magnitude, as for instance the eighth, contains 2·512 times the light of the next less, or ninth magnitude. A comparison of the brightest predicted magnitude of any planet with the number in column M, will show whether such planet is favourably situated for observation in the year 1857 or not. Thus, for *Polyhymnia*, which comes in opposition about the middle of March, when a little past its aphelion passage, the brightest magnitude will be 12·7, or 1·5 magnitude fainter than if at mean distance; while for *Phocea*, which will be very favourably situated at its opposition in July, the sun being in apogee and *Phocea* in perihelion, the magnitude will be 1·5 brighter than at mean distance. It must, however, be remembered, that an error in the assumed value of M for any planet will cause a corresponding error in the ephemeris throughout the year, and at present these quantities are by no means satisfactorily determined, especially for the more recently discovered planets. But, perhaps, the greatest use of such an ephemeris will be on the occasion of the earliest observations after conjunction, when an approximate knowledge of the magnitude may save the annoyance of mistaking an adjacent star for the object sought, an accident of too common occurrence even to experienced observers. Six planets have been omitted for want of ephemerides: for one of these, *Daphne*, no elements have yet been computed. For the remaining five, the numbers M may be taken as follows:—*Leucothœa*, 12·5; *Leda*, 11·5; *Lætitia*, 8·8; *Harmonia*, 8·5; and *Isis*, 10·3. Their magnitudes at any time may then be found by the formula,—

$$m = \mathrm{M} - 5 \log (a \,.\, \overline{a - 1}) + 5 (\log r + \log \Delta).$$

The magnitude-ephemeris will also be a severe test of the truth of the adopted light ratio; for if that ratio be really the one employed by the majority of observers, the correction for any one planet will be the constant one due to the number in the column M; but if, on the contrary, the ratio should be false, the ephemeris will run wide of truth, especially as each planet approaches conjunction, but this I do not anticipate.

The considerations which led to the adoption of the light ratio here employed were as follows:—I had read with much interest the remarks made by the Rev. W. R. Dawes, in the *Monthly Notices*, vol. xi. pages 187–198, and intended to make use of his proposed ratio of 4, when the very different result of 2·43, obtained by Mr. Johnson from his heliometric equalisation experiments, as given in his appendix to vol. xii. of the *Radcliffe Observations*, on the 'Photometry of Stars,' threw uncertainty upon a matter I had regarded as settled. The subject being one of especial importance in the pursuits which had occupied most of my leisure hours, viz., chart-making and variable star-observing, I at once set to work with a little modification of the method of reduced apertures,

to see which result my own observations would yield the nearest approximation to. I must even confess to having entertained at starting a little bias in favour of the ratio given by Mr. Dawes. Instead of reducing stars to a *minimum visible*, their total extinction was preferred, as being more certain. Having found by trial the apertures with which certain stars of assumed magnitude were lost sight of, these measures were grouped together, and submitted to the formula,—

$$(M - m) \log R = 2 (\log A - \log a).$$

in which R is the required ratio; M, *m*, the magnitudes of stars as widely different as possible, and A, *a*, the respective apertures with which each star vanished. The assumed magnitudes were taken from the *Radcliffe Observations*, from the zones of Argelander and Bessel, and from the catalogues of Piazzi, Lalande, and Groombridge, so as to find the ratio of each observer separately. The ratios thus found were remarkably accordant: the mean of all, 2·4. This result, derived by a perfectly independent method, was an unexpected verification of Mr. Johnson's ratio of 2·43. (The decreasing ratio of 0·412 was given by Mr. Johnson, but I prefer using its reciprocal.) Shortly afterwards I learnt that Steinheil, of Munich, had deduced a ratio of 2·83, by experiments upon 26 stars between the 1st and 4th magnitudes. Prof. Stampfer found, from 132 stars between the 4th and 9·5 magnitudes, a ratio of 2·519. Finally, Argelander has endorsed this ratio with his high authority upon such matters, by adopting it as the basis of his formulæ for computing the magnitudes of the minor planets. It signifies little which of these ratios is adopted in dealing with the ranges of ordinary telescopes. I selected 2·512 for convenience of calculation, as the reciprocal of $\frac{1}{2}$ log R, a constant continually occurring in photometric formulæ, is in this case exactly 5. If then any observer will determine for himself the smallest of Argelander's magnitudes just discernible by fits, on a fine moonless night, with an aperture of one inch, and call this quantity L, or the limit of vision for one inch, the limit *l*, for any other aperture, will be given for the simple formula,—$l = L + 5 \times \log$ aperture.

Numerous comparisons, made with various telescopes and powers, at different seasons of the year, have furnished me with the value $L = 9{\cdot}2$ for my own sight, which is, I believe, a very average one, and therefore suitable for such a determination. As a verification of these results, Mr. Hind, who has extended Bessel's scale downwards in the construction of Mr. Bishop's Ecliptical Charts, has considered that with the South Villa equatoreal of 7 inches aperture, "a faint glimmering," to use his own words, was about a 13 or 13·14 magnitude. By the formula, we have for 7 inches, $l = 9{\cdot}2 + 5 \log 7 = 13{\cdot}4$ magnitude. Again, a 6th magnitude of Argelander is, *by trial*, my limit for an aperture of 0·23 inch. The formula gives for such an aperture, $l = 9{\cdot}2 + 5 \log 0{\cdot}23 = 6{\cdot}0$ magnitude.

It appears, then, that whatever they may have intended, nearly all the great catalogue-makers have involuntarily fallen into this ratio, or one so nearly the same as to be practically identical.

True, they have not all adopted precisely the same standard of brightness for any one magnitude, but if we take Argelander's 8th or 9th magnitudes and this ratio, all will be sufficiently close to fall considerably within the errors of estimation. Lalande's 6ths and 7ths are perhaps the most out; the rest present on the whole very fair agreement.

It remains to treat of those who have adopted a different ratio. Struve has divided the stars between the limits of naked-eye vision and of his 15-inch refractor into 6 magnitudes, *i. e.* he has made 12th magnitude the limit of vision for his instrument. The formula gives 15·1 magnitude for its limit. Mr. Dawes has adopted Struve's magnitudes, and therefore the same table will apply to both. Mr. Bond, with a similar telescope, has gone to the 20th magnitude, starting from Bessel's 9th magnitude. But according to the proportional apertures given for stars from the 9th to the 12th magnitudes on page liv. of the Introduction to the *Harvard Zone Observations*, he has not followed any fixed ratio in these four magnitudes, so all that can done is to tabulate for these, and simply interpolate between his 12ths and 20ths. For Sir John Herschel's estimates I must assume, as in Mr. Dawes' table, agreement with other authorities at the 6th magnitude, but that his 18th equals Struve's 12th (my 15·1 magnitude). Admiral Smyth in his *Cycle* took 16th magnitude as the limit for his aperture of 5·9 inches. The formula gives 13th magnitude, and supposing that his 8th magnitude was the point of departure from Piazzi, whose brighter magnitudes he professedly conformed to, we may interpolate the intermediate magnitudes.

The following table exhibits these equivalents in a collected form. The first, or standard column, contains Argelander's scale, extended to the lower magnitudes by the adopted ratio; the second, the apertures required by an average sight to reduce such stars to a limit of vision, and the remaining columns, the corresponding magnitudes of Struve, Bond, Herschel, and Smyth:—

Standard Magnitudes.	Apertures in Inches.	Corresponding Magnitudes of Struve.	Bond.	Herschel.	Smyth.
6	0·229	6·0	6·0	6·0	6·0
7	0·363	6·6	7·0	7·3	7·0
8	0·575	7·3	8·0	8·6	8·0
9	0·912	8·0	9·0	10·0	9·6
10	1·44	8·6	10·0	11·3	11·2
11	2·29	9·3	11·6	12·6	12·8
12	3·63	10·0	12·9	13·9	14·4
13	5·75	10·6	15·2	15·2	16·0
14	9·12	11·3	17·5	16·6	
15	14·4	11·9	19·8	17·9	

Oxford.

Results of the Observations of Small Planets made at the Royal Observatory, Greenwich, in the Month of October, 1856.

(*Communicated by the Astronomer Royal.*)

Hygeia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Oct. 20 7 16 46·8	21 14 29·62	102 37 33·05
22 7 9 34·9	21 15 9·75	102 35 18·38

Fortuna.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Oct. 1 11 46 14·7	0 29 47·33	85 35 21·61
13 10 49 18·3	0 20 0·18	86 49 29·06
21 10 9 14·6	0 14 49·33	87 33 32·09
30 9 33 24·1	0 10 54·93	88 10 44·93

Eunomia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Oct. 27 10 7 38·0	0 33 24·80	63 19 44·81
28 10 3 5·0	0 32 47·58	63 27 50·08

Thalia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Oct. 13 12 14 12·5	1 45 8·34	91 39 31·79
21 11 34 58·4	1 37 20·19	92 2 7·22
27 11 5 32·5	1 31 28·81	92 13 47·36

Massilia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Oct. 21 12 46 40·5	2 49 14·08	73 57 31·36
25 12 27 25·2	2 45 41·90	74 15 12·08
27 12 17 42·2	2 43 50·39	74 24 21·80

Melpomene.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Oct. 21 12 34 41·4	2 37 13·01	95 7 25·25
27 12 6 42·2	2 32 48·60	95 58 10·74

Oct. 21. It is doubtful whether the object observed is the planet.

On the Projection of Stars on the Disk of the Moon.

By Capt. W. S. Jacob.

"I have now to communicate a veritable case (or rather two cases) of projection of stars on the moon's face, the first that I have seen quite satisfactorily; for though I have often noticed something of the kind, there has generally been some defect of definition, or other ground for suspecting the accuracy of the observation.

"In the present instance, I was waiting for the immersion of 23 *Tauri* on the 18th instant. The sun had just risen, and there was a thick haze, so that the star was rather dim; but I saw it plainly enough. The moon's limb advanced and touched it, but the star did not disappear; it continued to advance till the star was entirely on the moon's face, and then suddenly disappeared, several seconds after contact with the limb. The immersion of η followed about an hour later; the daylight was stronger, but the haze had somewhat cleared, and the star being intrinsically brighter, I saw it much better than 23; the same phenomenon as before was repeated. My impression at the time was, that the star advanced rather *more* than its whole breadth on the moon; but on reflection immediately after, I could not be *quite* sure that I had seen any part of the moon *outside* of the star; but certainly the whole light of the star was on the moon. Irradiation can hardly be admitted in the present instance, the observation being made in daylight.

"On the 21st I saw one of *Jupiter's* satellites for the first time with the naked eye; I have often looked for them before, but without success. *Jupiter* was shining very bright and clear, with little radiation; I looked at him with an eyeglass—a single lens, of long focus, and plainly saw a small point near him, and could get glimpses of it with the naked eye. My sight is not very good without glasses. To make sure there was no delusion, I asked a person who was with me, 'Do you see anything unusual about *Jupiter?*' 'Yes, there is a small star almost touching him below.' 'Is it exactly below?' 'No, a little to the left;' which was the true position. The satellite was the third, which was the largest of the four, and was near elongation. With the eyeglass, I had a

suspicion of another, nearer the planet; and on examination there were found the first and second, near together, whose united light may have slightly impressed my vision.

"*Observatory, Madras, 26th September*, 1856."

Annular Solar Eclipse, September 18th (*Greenwich*, 17^{d}), 1857. By J. F. Tennant, Lieut. Engineers, 1st Asst. Gt. Trig. Survey of India.

"The accompanying table has been circulated, as far as I have been able, among those likely to furnish observations; but as I can find few of the Fellows, perhaps you would admit it in the *Monthly Notices* for more extensive circulation among parties likely to be interested. The computations have been verified by a brother officer.

Calculated Positions of the Central and Limiting Lines for the Annular Appearance within Indian Longitudes.

Southern Limit.		Central Line.		Northern Limit.	
Lat. N.	Long. E.	Lat. N.	Long. E.	Lat. N.	Long. E.
° ′	° ′	° ′	° ′	° ′	° ′
35 28·7	66 59·4	36 5·4	67 17·2	36 42·5	67 34·3
34 10·2	70 50·0	34 45·1	71 9·8	35 20·3	71 28·9
32 51·0	74 4·7	33 24·3	74 25·8	33 57·6	74 46·8
31 32·2	76 52·4	32 3·9	77 14·7	32 35·7	77 36·9
30 13·8	79 19·6	30 44·1	79 42·9	31 14·5	80 6·1
28 55·7	81 31·0	29 24·5	81 54·9	29 53·6	82 18·8
27 38·1	83 29·0	28 5·7	83 53·6	28 33·2	84 18·1
26 20·6	85 16·3	26 47·0	85 41·3	27 13·7	86 6·4
25 3·4	86 54·6	25 28·9	87 20·0	25 54·4	87 45·4
23 46·4	88 25·5	24 11·1	88 51·0	24 35·5	89 17·0
22 30·4	89 49·7	22 54·0	90 15·6	23 17·7	90 41·5
21 14·2	91 8·4	21 37·1	91 34·5	22 0·0	92 0·7
19 58·4	92 22·6	20 20·5	92 48·9	20 42·7	93 15·3
18 42·8	93 32·9	19 4·3	93 59·3	19 25·9	94 25·7
17 27·5	94 39·9	17 48·6	95 6·3	18 9·8	95 32·8
16 12·3	95 44·1	16 33·0	96 10·6	16 53·5	96 37·2
14 57·1	96 46·0	15 17·4	97 12·6	15 37·6	97 39·2
13 42·8	97 46·6	14 2·5	98 13·1	14 22·5	98 39·7
12 27·4	98 45·4	12 47·4	99 11·9	13 7·3	99 38·5
11 12·6	99 43·2	11 32·5	100 9·9	11 52·3	100 36·6

N.B.—Observations with the true times and geographical position of the place will be very acceptable.

"*Masuri, September 15th*, 1856."

Observation of α Centauri. By Capt. W. S. Jacob.

" This is my last mean for *α Centauri.*

	Position.	Distance.	
1856·591	310°·54	3″·882	Mean of 5 days' observations.

" The minimum dist. appears to be past.

" *Observatory, Madras,* 11 *Sept.* 1856."

Two papers by W. Simms, Jun. Esq.— one on the Corrections to be applied to Observations with the Sextant, the other, Formulæ for the Determination of Latitude by Means of Observed Transits of Stars near the Prime Vertical — were also read. Abstracts of these will appear in the next number.

Mr. Warren De La Rue has sent for distribution copies of an engraving of the planet *Saturn* for 1856, the epoch of the greatest opening of the rings. Application for copies is to be made to the Assistant-Secretary at the Apartments of the Society.

ERRATA, VOL. XVI.

Page 155, *dele* the observation of *Lætitia*, on March 31, and the foot-note to that on March 26.

— 217, in the observation of *Eunomia*, on Sept. 4, *read* App. R.A., $1^h\ 12^m\ 13^s{\cdot}27$, *for* $1^h\ 12^m\ 10^s{\cdot}87$.

— 219, *dele* the observation of *Hygeia*, on Sept. 29.

— 224, 8th line from top, *for* $1^h\ 42^m\ 2^s{\cdot}208$ east, *read* $1^h\ 42^m\ 22^s{\cdot}08$ east.

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